

CHOOSING HOSE ASSEMBLIES FOR SAFETY'S SAKE

SAVING MONEY, REDUCING ACCIDENTS By Stephen Van Pelt, April 22, 2002

Although they might seem like simplistic and "single-minded" pieces of equipment, hose assemblies carry compressed gases and industrial, chemical and cryogenic liquids under tremendous amounts of pressure, in extreme temperatures and in physically demanding conditions.

The prevention of premature hose failure limits worker contact with poisonous, caustic or corrosive chemicals and helps reduce the high costs associated with mishaps such as those documented in the Occupational Safety and Health Administration's (OSHA) published accident reports.

When it comes to hose assemblies, plant engineers often assume the hose assembly they are using will continue to work well in the application. That is not necessarily so.

In the United States, hose is designed to a published four-to-one ratio safety factor, meaning the maximum allowable working pressure (MAWP) must be one-fourth the hose's minimum burst pressure, generally at a temperature of 72°F. The MAWP can be positive or negative, for pressurized or vacuum operating conditions.

Inner-core hose construction is application dependent.

Many within the plant environment are unaware that as temperature increases, hose-assembly MAWP decreases. Therefore, it is imperative for plant personnel to evaluate hose products properly by requesting and reviewing the manufacturer's printed temperature correction curves and factors before making a purchasing decision.

Hose assemblies generally are the weakest link in a piping system because they are usually made from materials that promote flexibility. It stands to reason that rigid systems are more durable than flexible lines. However, hose assemblies must be

flexible to facilitate piping misalignments, increase efficiency in processes having many connected parts, and act as vibration isolators and dampeners.

Selection Guidelines

Most factories and production facilities use hoses, which could eventually wear out and require replacement. Integral to enhancing and facilitating plant and factory maintenance repair and operations (MRO), then, is proper selection of hose assemblies based on precise specifications.

In hose specification, many factors come into play, including those identified by the National Association of Hose and Accessories Distributors (NAHAD). NAHAD publishes a simple-to-use guide that assists in determining the correct hose, coupling and attachment method that will satisfy the needs of particular applications. The NAHAD guide uses the "STAMPED" acronym to identify the seven major information areas — size, temperature, application, material, pressure, ends and delivery — required for specification of a suitable hose assembly.

Hose assemblies are composed of end fittings, an inner core, pressure/vacuum reinforcement or reinforcing layers and a protective outer cover. Materials of construction for the inner core, end fittings, reinforcements and protective cover can vary, based on the STAMPED analysis.

Inner core. Although all hose parts are equally important, the first part that should be considered is the inner core, which directly contacts the media being conveyed.

During the past 35 years, most hoses used in critical chemical applications have been manufactured with a fluoropolymer plastic inner core. This material offers performance characteristics such as a high temperature rating, flexibility, corrosion resistance and nonstick, non-

contaminating and nonaging properties.

The fluoropolymer inner core is available in two different styles: smooth and convoluted (corrugated). Whenever possible, a smooth tube inner diameter (ID) is the better choice because it affords less pressure drop and is easier to keep clean. When changing chemicals, it ensures cross-contamination and reactions do not occur.

However, when using larger diameters (typically greater than 3/4-inch [in.] size ID), a smooth tube made from fluoropolymer could have an increased bend radius and require more force to bend than a convoluted fluoropolymer tube. When flexibility is the primary concern, a convoluted fluoropolymer hose is the best choice for large-diameter sizes.

End fittings. End fittings also are important considerations because they come into contact with the media. Common end-fitting materials include 300 series stainless steel, Monel and Hastelloy.

An inner core flared-over flange fitting, constructed of fluoropolymer-encapsulated stainless steel, has rapidly become recognized as the premier choice among end fittings. The wetted surface of the end fitting exhibits the same chemical compatibility as the wetted surface of the hose. This type of fitting is highly corrosion-resistant and inert to most conveyed chemicals.

Proper end-fitting designs can ensure efficient, leak-proof material transfer and safe long-term operation.

An innovative alternative to encapsulated end fittings that also has gained popularity is one that features an inner core through the ID. Here, the inner core of the hose is extended continuously through the ID of the fitting and molded over the sealing surface.

This design has distinct advantages over a standard metal fitting or even

a plastic encapsulated fitting. It offers the same chemical compatibility and corrosion resistance of the inner core of the hose plus the added benefit of seamless transition from hose to fitting. Flow is not reduced by a decrease in the ID, as found in encapsulated fittings.

This end-fitting design makes the hose assembly much easier to clean, allowing hose assemblies to be used for diverse applications without the threat of cross-contamination or the cost of purchasing individual hose assemblies for each media application.

The ID of the hose remains constant all the way to the sealing surface of the fitting. Minimal entrapment areas maintain product purity and minimize possible corrosion sites. In addition, fitting length is reduced by 40 percent to 50 percent, enabling shorter overall hose assembly length and increasing flexibility.

Popular end-fitting styles used in the chemical industry today also include cam and groove, lap joint flange and clamp-style sanitary fittings.

Reinforcement layers.
Reinforcements, located between the inner tube and the optional outer protective cover, fortify and strengthen the tube while improving flexibility at the same time. Many types of reinforcement materials are available, including woven fabric embedded in rubber, spiral cable and solid wire.

Generally, the type of reinforcement and its material of composition determine the pressure rating of the hose.

One of the more popular reinforcement types is multi-stranded braiding. From a manufacturing standpoint, braiding is cost-efficient and highly effective while remaining flexible. Popular materials of construction include 300 series stainless steel and plastics such as polypropylene, polyvinylidene fluoride (PVDF) and polyester.

Stainless steel is used most commonly because it has high temperature ratings, good corrosion resist-

ance and a relatively low cost. Stainless steel braided reinforcement generally is acceptable with a large variety of inner-core materials.

Plastic reinforcement characteristics include excellent corrosion resistance, lower force-to-bend specifications and a lighter weight. Plastic reinforcement often is more durable and prevents abrasion. However, resistance to ultraviolet (UV) light effects also must be considered when choosing plastic braided reinforcements because UV light can adversely affect braid integrity and longevity.

Some braided reinforcements might require additional protection in environments in which excessive dragging or harsh chemical exposure could compromise the integrity of the pressure-carrying capabilities of braided hose assemblies. If the reinforcement is damaged as a result of cutting, abrasion, kinking or over-bending, the pressure rating of the hose assembly will be reduced drastically and could lead to premature failure.

Protective outer cover. The cover, as well as the reinforcement, should be compatible with the chemicals running through the hose. Some chemicals can permeate through the inner core and come into contact with the cover and the reinforcement, resulting in safety and performance concerns.

A properly specified cover can act as an insulator (to protect the operator and the environment) against the potentially extreme hot and cold temperatures of the media running through the hose. It also can protect the reinforcement from being damaged and provide kink resistance. A smooth cover also facilitates cleaning of exterior surfaces.

Hose Maintenance

Indeed, the specification of proper hose components is vital to MRO and general manufacturing procedures. Plant personnel should inspect hoses routinely and replace them upon any signs of damage, bulging, flat spots, kinks or broken or worn braid. Corroded end fittings

or reinforcements also should be replaced.

This is a responsibility that is shared by operations, maintenance and supervisory personnel. On-the-spot inspection and open reporting of potential hose damage is vital and should be encouraged by plant management.

Clearly, hose assembly service life in the chemical processing environment is directly impacted by dynamics that include pressure surges, mechanical damage, over-bending or kinking, exterior chemical exposure and misapplication. However, an extended service life can be expected if the hose assemblies are selected correctly for the application and properly maintained.

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